



# Cable Modem Steering

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The cable modem steering feature helps to redirect or steer cable modems to multiple CMTS routers. A configurable string is used to bond the cable modem to the proper CMTS. Once the bonding is done, the CMTS can move the cable modem within itself for load balancing.

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## Cable Modem Steering on the Cisco cBR Series Converged Broadband Routers

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The cable modem steering feature helps to redirect or steer cable modems to multiple CMTS routers. A configurable string is used to bond the cable modem to the proper CMTS. Once the bonding is done, the CMTS can move the cable modem within itself for load balancing.

### Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

## Contents

# Prerequisites for Cable Modem Steering

DOCSIS 3.0-defined type, length, values (TLVs) are required to aid channel selection. All TLVs encoded as general extension information in cable modem configuration files are backward compatible with DOCSIS 1.1 and DOCSIS 2.0 cable modems.



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**Note** The hardware components introduced in a given Cisco IOS Release are supported in all subsequent releases unless otherwise specified.

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# Restrictions for Cable Modem Steering

The Cable Modem Steering feature has the following general restrictions:

- To restrict the cable modem on the exact downstream on the target CMTS, the redirection must be configured on the target CMTS.
- You must manually execute the **clear cable modem service-type** command to clear the cable modem service type identifier stored at the CMTS during registration.
- You must manually execute the **clear cable modem attribute-masks** command to clear the cable modem attribute masks stored at the CMTS during registration. These attribute masks are used to restrict usage of upstream channels during ranging time.
- Cable modem steering supports only upstream masks.
- Channel steering does not take place when the cable modem fails in initial ranging.
- The cable modem will take more time to come online when channel steering is deployed. The time taken is proportional to the number of modems, and the downstreams and upstreams that the cable modem can reach.
- A modem cannot be load balanced to any upstream channel with attributes that conflict with attribute masks of the modem.
- Do not configure to use UCC in DOCSIS LBG.

# Information About Cable Modem Steering

Cable modem steering allows you to redirect or steer the cable modems to one or more CMTS routers using downstream frequency overrides. Once a cable modem registers on a downstream on the proper CMTS router, the CMTS router can move the cable modem to any location for load balancing.

The DOCSIS 3.0-compliant Service Type Identifier used as the configurable string in the cable modem configuration file is backward-compatible with DOCSIS 1.1 and DOCSIS 2.0 cable modems.

The CMTS router can also impose restrictions on the number of channels a cable modem can use. DOCSIS 3.0 defines several TLVs to aid the channel selection.

The following TLVs are used in cable modem steering:

- TLV 43.9 (Cable Modem Attribute Masks) limits the set of channels the CMTS router can assign to the cable modem by allowing or forbidding certain binary attributes. The cable modem attribute masks have four sub-TLVs and cable modem steering makes use of two sub-TLVs, which are listed below:
  - TLV 43.9.3—Cable Modem Upstream Required Attribute Mask (C.1.1.18.1.8.3 of CM-SP-MULPIv3.0-I07-080215). It is a 32-bit mask representing the set of binary upstream channel attributes required for the cable modem.
  - TLV 43.9.4—Cable Modem Upstream Forbidden Attribute Mask (C.1.1.18.1.8.4 of CM-SP-MULPIv3.0-I07-080215). It is a 32-bit mask representing the set of binary upstream channel attributes forbidden for the cable modem.
- TLV 43.11 is used for a redirection action based on the service type identifier field. The cable modem sends the TLV 43.11 in the REG-REQ MAC message. The DOCSIS 1.1 and DOCSIS 2.0 modems will also send this file ID when doing the registration.
- TLV 43.1, defined as Policy ID in DOCSIS 2.0 and DOCSIS 3.0, is parsed and stored in the cable modem during registration. Before moving the cable modem during load balancing (LB), the CMTS router checks whether the cable modem has a preconfigured policy with the same Policy ID. If the policy does exist, the CMTS router disables LB for this cable modem and moves to the next cable modem. If the policy does not exist on the CMTS router, or the Policy ID is missing from the cable modem configuration file, LB prohibition is not performed.

The following TLVs are supported in cable modem steering:

- TLV 43.11 (Service type identifier) from section C.1.1.18.1.10 in CM-SP-MULPIv3.0-I07-080215.
- Cable modem attribute masks (TLV 43.9) from C.1.1.18.1.8.3 and C.1.1.18.1.8.4 of CM-SP-MULPIv3.0-I07-080215.
- TLV portion (43.1, Policy ID) of REG-REQ
- TLV 18--- Ranging Hold-off Priority Field
- TLV 19---Channel Class ID

## Upstream Channel Descriptor TLV for Ranging Hold-off

The Upstream Channel Descriptor (UCD) TLV for Ranging Hold-off feature, enables the Cisco cBR Series Converged Broadband router to hold off a cable modem from initial ranging based on TLV 18 and 19 specified in the upstream channel descriptor (UCD) messages. The router can hold off a cable modem from initial ranging only for 5 minutes. This default value cannot be changed. This feature is supported with DOCSIS 2.0 and later releases cable modems using upstream logical channels.

### Ranging Class ID

The CMTS enables UCD TLV for ranging hold-off after detecting the TLVs from the cable modem registration request (REG-REQ) or multipart registration request (REG-REQ-MP), and saves these TLVs as a cable modem ranging class ID.

By default, DOCSIS load balance is supported for all cable modems with all types of ranging class IDs. In the event of DOCSIS load balance, a cable modem moves to the target upstream channel only if the ranging class ID matches with the upstream channel class ID.

### Cable Modem Exclusion for DOCSIS Load Balance

You can exclude a cable modem or a group of cable modems from DOCSIS load balance based on their device type, MAC address, and Organizational Unique Identifier (OUI) using the **cable load-balance exclude** command in global configuration mode.

# How to Configure Cable Modem Steering on the CMTS Router

This section describes the following required and optional procedures:

## Configuring an Upstream Channel Class ID

This configuration is optional. A channel class ID must be configured for an upstream logical channel if you want to configure UCD TLV ranging hold-off on the CMTS router.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 3</b>	<b>controller upstream-cable</b> <i>slot/subslot/controller-port-number</i> <b>Example:</b> Router(config)# <b>controller Upstream-Cable 3/0/0</b>	Specifies the cable interface and enters cable interface configuration mode. Arguments for this command may vary depending on the CMTS router, line card, and Cisco IOS software release. For details, see the <a href="#">Cisco IOS CMTS Cable Command Reference</a> . <ul style="list-style-type: none"> <li>• <i>Slot</i>— Slot where the interface card resides. The valid range is from 0 to 3 and 6 to 9 on the Cisco cBR-8 router.</li> <li>• <i>Subslot</i>—Subslot where the interface card resides. The valid value is 0 on the Cisco cBR-8 router.</li> <li>• <i>controller-port-number</i>—Controller port number. The valid values are from 0 to 7 on the Cisco cBR-8 router.</li> </ul>
<b>Step 4</b>	<b>us-channel</b> <i>us-channel-id</i> <b>chan-class-id</b> <i>id</i> <b>Example:</b> Router(config-controller)# <b>us-channel 3</b> <b>chan-class-id ff</b>	Configures the channel class ID for an upstream logical channel. <ul style="list-style-type: none"> <li>• <i>us-channel-id</i>—Specifies the upstream channel id.</li> <li>• <i>id</i>—Channel class ID for the logical upstream channel in the hexadecimal format. The valid range is from 0 to ffffffff. The default value is 0.</li> </ul>
<b>Step 5</b>	<b>end</b> <b>Example:</b> Router(config-controller)# <b>end</b>	Returns to privileged EXEC mode.

## Configuring an Upstream Ranging Hold-off Priority Value

This configuration is optional.

Maximum time that a cable modem can inhibit transmissions on an upstream channel in response to its ranging class ID matching a bit value in the Ranging Hold-off Priority field in the cable modem configuration file is 300 seconds (five minutes) per *DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification*. This default timer value cannot be changed.

### Procedure

	Command or Action	Purpose
Step 1	<b>enable</b> <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
Step 3	<b>controller upstream-cable</b> <i>slot/subslot/controller-port-number</i> <b>Example:</b> Router(config)# <b>controller upstream-cable 3/0/0</b>	Specifies the cable interface and enters cable interface configuration mode. Arguments for this command may vary depending on the CMTS router, line card, and Cisco IOS software release. For details, see the <a href="#">Cisco IOS CMTS Cable Command Reference</a> . <ul style="list-style-type: none"> <li>• <i>Slot</i>—Slot where the interface card resides. The valid range is from 0 to 3 and 6 to 9 on the Cisco cBR-8 router.</li> <li>• <i>Subslot</i>—Subslot where the interface card resides. The valid value is 0 on the Cisco cBR-8 router.</li> <li>• <i>controller-port-number</i>—Controller port number. The valid values are from 0 to 7 on the Cisco cBR-8 router.</li> </ul>
Step 4	<b>us-channel us-channel-id rng-holdoff priority</b> <b>Example:</b> Router(config-controller)# <b>us-channel 3 rng-holdoff 1</b>	Configures the ranging hold-off priority value for an upstream logical channel. <ul style="list-style-type: none"> <li>• <i>us-channel-id</i>—Specifies the upstream channel id.</li> <li>• <b>rng-holdoff priority</b>—Specifies the ranging hold-off priority value in the hexadecimal format. The valid range is from 0 to fffffff. The default value is 0.</li> </ul>
Step 5	<b>end</b> <b>Example:</b> Router(config-controller)# <b>end</b>	Returns to privileged EXEC mode.

# Verifying and Troubleshooting Cable Modem Steering

This section provides the verification and troubleshooting information:

## Verifying an Upstream Ranging Class ID Configuration

To verify an upstream ranging class ID of a cable modem, use the **show cable modem** command with the **verbose** keyword.

Following is a sample output of the **show cable modem verbose** command:

```
Router# show cable modem 68b6.fcfe.22e5 verbose

MAC Address           : 68b6.fcfe.22e5
IP Address            : 192.168.0.8
IPv6 Address         : 2001:DB8:10:1:9951:1972:33F9:9867
Dual IP              : Y
Prim Sid             : 8
Host Interface       : C8/0/0/UB
MD-DS-SG / MD-US-SG : 1 / 2
MD-CM-SG            : 0x5A0102
Primary Wideband Channel ID : 3073 (Wi8/0/0:0)
Primary Downstream   : Mo8/0/0:0 (RfId : 2304)
Wideband Capable    : Y
RCP Index           : 3
RCP ID              : 00 10 00 00 18
Downstream Channel DCID RF Channel : 45 8/0/0:0
Downstream Channel DCID RF Channel : 46 8/0/0:1
Downstream Channel DCID RF Channel : 47 8/0/0:2
Downstream Channel DCID RF Channel : 48 8/0/0:3
Downstream Channel DCID RF Channel : 49 8/0/0:4
Downstream Channel DCID RF Channel : 50 8/0/0:5
Downstream Channel DCID RF Channel : 51 8/0/0:6
Downstream Channel DCID RF Channel : 52 8/0/0:7
Downstream Channel DCID RF Channel : 53 8/0/0:8
Downstream Channel DCID RF Channel : 54 8/0/0:9
Downstream Channel DCID RF Channel : 55 8/0/0:10
Downstream Channel DCID RF Channel : 56 8/0/0:11
Downstream Channel DCID RF Channel : 57 8/0/0:12
Downstream Channel DCID RF Channel : 58 8/0/0:13
Downstream Channel DCID RF Channel : 59 8/0/0:14
Downstream Channel DCID RF Channel : 60 8/0/0:15
Downstream Channel DCID RF Channel : 61 8/0/0:16
Downstream Channel DCID RF Channel : 62 8/0/0:17
Downstream Channel DCID RF Channel : 63 8/0/0:18
Downstream Channel DCID RF Channel : 64 8/0/0:19
Downstream Channel DCID RF Channel : 65 8/0/0:20
Downstream Channel DCID RF Channel : 66 8/0/0:21
Downstream Channel DCID RF Channel : 67 8/0/0:22
Downstream Channel DCID RF Channel : 68 8/0/0:23
UDC Enabled          : N
Extended Upstream Transmit Power : 61dB
Multi-Transmit Channel Mode : Y
Number of US in UBG : 8
Upstream Channel     : US0      US1      US2      US3
Ranging Status      : sta      sta      sta      sta
Upstream SNR (dB)   : 30.62   32.32   18.25   24.26
Upstream Data SNR (dB) : --      --      --      --
Received Power (dBmV) : 0.50    0.00   -0.50   -0.50
Reported Transmit Power (dBmV) : 30.75   30.75   29.25   29.25
```

```

Peak Transmit Power (dBmV)      : 61.00      61.00      61.00      61.00
Phy Max Power (dBmV)           : 48.00      48.00      48.00      48.00
Minimum Transmit Power (dBmV)   : 21.00      21.00      21.00      21.00
Timing Offset (97.6 ns)        : 1800      1800      1800      1800
Initial Timing Offset          : 1544      1544      1544      1544
Rng Timing Adj Moving Avg(0.381 ns): -1         0         -1         -1
Rng Timing Adj Lt Moving Avg   : -7         0         -7         -7
Rng Timing Adj Minimum         : -256      0         -256      -256
Rng Timing Adj Maximum         : 65536     65536     65536     65536
Pre-EQ Good                    : 0         0         0         0
Pre-EQ Scaled                  : 0         0         0         0
Pre-EQ Impulse                 : 0         0         0         0
Pre-EQ Direct Loads            : 0         0         0         0
Good Codewords rx              : 1201      1262      833       656
Corrected Codewords rx         : 0         0         169       117
Uncorrectable Codewords rx     : 0         0         205       335
Phy Operating Mode              : atdma*    atdma*    atdma*    atdma*
Upstream Channel                : US4       US5       US6       US7
Ranging Status                  : sta       sta       sta       sta
Upstream SNR (dB)               : 15.53     31.62     31.1      31.87
Upstream Data SNR (dB)         : --        --        --        --
Received Power (dBmV)          : 0.00      0.00      -0.50     0.50
Reported Transmit Power (dBmV) : 29.25     30.75     30.75     30.75
Peak Transmit Power (dBmV)     : 61.00     61.00     61.00     61.00
Phy Max Power (dBmV)           : 48.00     48.00     48.00     48.00
Minimum Transmit Power (dBmV)   : 21.00     21.00     21.00     21.00
Timing Offset (97.6 ns)        : 1800      1800      1800      1800
Initial Timing Offset          : 1544      1800      1544      1544
Rng Timing Adj Moving Avg(0.381 ns): -1        -1         46         0
Rng Timing Adj Lt Moving Avg   : -7        -7        104        0
Rng Timing Adj Minimum         : -256     -256      0          0
Rng Timing Adj Maximum         : 65536     256       65536     65536
Pre-EQ Good                    : 0         0         0         0
Pre-EQ Scaled                  : 0         0         0         0
Pre-EQ Impulse                 : 0         0         0         0
Pre-EQ Direct Loads            : 0         0         0         0
Good Codewords rx              : 718       1328     1173      1252
Corrected Codewords rx         : 110       0         0         0
Uncorrectable Codewords rx     : 298       0         0         0
Phy Operating Mode              : atdma*    atdma*    atdma*    atdma*
sysDescr                        : DOCSIS 3.0 Cable Modem Router
Downstream Power                : 7.40 dBmV (SNR = 43.30 dB)
MAC Version                      : DOC3.0
QoS Provisioned Mode            : DOC1.1
Enable DOCSIS2.0 Mode          : Y
Modem Status                     : {Modem= w-online, Security=disabled}
Capabilities                     : {Frag=N, Concat=N, PHS=Y}
Security Capabilities           : {Priv=, EAE=Y, Key_len=}
L2VPN Capabilities              : {L2VPN=Y, eSAFE=Y}
Sid/Said Limit                  : {Max US Sids=8, Max DS Sids=64}
Optional Filtering Support       : {802.1P=N, 802.1Q=N, DUT=Y}
Transmit Equalizer Support       : {Taps/Symbol= 1, Num of Taps= 24}
Number of CPE                   : 0(Max CPE = 16)
Number of CPE IPs               : 0(Max CPE IPs = 16)
Number of CPE IPv6              : 0(Max CPE IPv6 = 16)
CFG Max-CPE                     : 16
Flaps                            : 19(Oct 11 04:00:25)
Errors                           : 0 CRCs, 0 HCSes
Stn Mtn Failures                : 0 aborts, 12 exhausted
Total US Flows                  : 1(1 active)
Total DS Flows                  : 1(1 active)
Total US Data                    : 3294 packets, 577031 bytes
Total US Throughput              : 0 bits/sec, 0 packets/sec
Total DS Data                    : 2263 packets, 200777 bytes

```

```

Total DS Throughput           : 0 bits/sec, 0 packets/sec
LB group ID assigned (index)  : 2153382146 (55810)
LB group ID in config file (index) : N/A (N/A)
LB policy ID                  : 0
LB policy ID in config file   : 0
LB priority                   : 0
Tag                           :
Required DS Attribute Mask    : 0x0
Forbidden DS Attribute Mask   : 0x0
Required US Attribute Mask    : 0x0
Forbidden US Attribute Mask   : 0x0
Service Type ID              :
Service Type ID in config file :
Ranging Class ID           : 0x2
Active Classifiers            : 0 (Max = NO LIMIT)
CM Upstream Filter Group      : 0
CM Downstream Filter Group    : 0
CPE Upstream Filter Group     : 0
CPE Downstream Filter Group   : 0
DSA/DSX messages              : permit all
Voice Enabled                 : NO
DS Change Times               : 0
Boolean Services              : 2
Number of Multicast DSIDs Support : 63
MDF Capability Mode           : 2
IGMP/MLD Version              : MLDv2
FCType10 Forwarding Support   : Y
Features Bitmask              : 0x0
Total Time Online             : 9h27m (9h27m since last counter reset)
CM Initialization Reason      : BAD_DHCP_ACK
CFG Max IPv6 CPE Prefix       : 16 (-1 used)

```

## Additional References

The following sections provide references related to the Cable Modem Steering feature.

### Related Documents

Related Topic	Document Title
CMTS cable commands	<a href="#">Cisco IOS CMTS Cable Command Reference</a>

### Standards and RFCs

Standard	Title
CM-SP-MULPIv3.0-I07-080215	DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification
CM-SP-MULPIv3.0-I18-120329	DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification
CM-SP-RFI2.0-I13-080215	DOCSIS 2.0 Radio Frequency Interface Specification



**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Cable Modem Steering

Use Cisco Feature Navigator to find information about the platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to the <https://cfng.cisco.com/> link. An account on the Cisco.com page is not required.



**Note** The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 1: Feature Information for Cable Modem Steering on the Cisco CMTS Routers**

Feature Name	Releases	Feature Information
Cable Modem Steering	Cisco IOS XE Everest 16.6.1	This feature was integrated into Cisco IOS XE Everest 16.6.1 on the Cisco cBR Series Converged Broadband Routers.

